

THE DISTRIBUTION AND ABUNDANCE OF THE OX WARBLES, *HYPODERMA LINEATA* AND *H. BOVIS* IN THE UNITED STATES.

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Considering the importance of the ox warbles as pests of cattle, it is odd that so little is known by entomologists regarding their distribution and relative abundance. It is well known that *H. lineata* is widely distributed in this country, but the fact that there are areas where this species is almost or entirely absent has not been recognized.

That the so-called European ox warble, *H. bovis*, is to be found over a considerable area in the northern portion of the United States has just been determined through investigations conducted by us during the past two years. In fact, this species has not been reported to occur in the United States except in a single instance. In this case, Prof. C. W. Johnson² reared this species from larvæ collected at Manchester, Vermont, in June, 1910. In the early work of Prof. C. V. Riley,³ in which a considerable number of larvæ from various parts of the country were examined, not a single specimen of *H. bovis* was obtained. In 1905, Prof. Aldrich⁴ states that *H. bovis* is not positively known from North America. In 1912, Dr. S. Hadwen⁵ announced the common occurrences of *H. bovis* at Agassiz, B. C., and in 1914 Dr. C. Gordon Hewitt⁶ reported that he had seen specimens of this species from Nova Scotia, Quebec, Ontario, Alberta, and Saskatchewan, thus indicating a distribution from the Atlantic to the Pacific in Canada.

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²Johnson, C. W., 1910, *Psyche* XVII, p. 231. December.

³Riley, C. V., 1892, *Insect Life*, IV, pp. 302-317, 12 Figs.

⁴Aldrich, J. M., 1905, *A Catalogue of North American Diptera*. Smithsonian Misc. Coll. XLVI, No. 1444, p. 416.

⁵Hadwen, S., 1912, *Bull. 16, Health of Animals Branch, Canada, Dept. Agr.* 20, pp. 9 pls.

⁶Hewitt, C. Gordon, 1914, *Can. Ent.*, XLVI, pp. 1-2.

DISTRIBUTION AND ABUNDANCE OF *Hypoderma lineata*.

It appears that this species is to be found in every State in the Union, although, as has been indicated, there is considerable difference in its abundance in different sections. During our inquiry into the distribution of ox warbles during the last two years, we have obtained specimens from thirty-one of the States, but there is no reason to suppose that the species is not common in all of the others. A total of about 140 lots was obtained during this investigation as a result of personal collections and specimens sent in by numerous correspondents.

In general, it appears that *H. lineata* is more abundant in the Southern and Central Western States than elsewhere in the country. However, the presence of the two species combined in Vermont and New Hampshire probably gives a heavier infestation there than is to be found elsewhere in the country.

We have found the species to occur commonly at all altitudes, from sea level to 9,000 feet. As is indicated by its wide distribution, it is also to be found in the humid, semi-arid and arid regions. Our inquiry thus far does not indicate that annual rainfall has any material effect on the abundance of the species. It is possible, however, that by closer study we shall find that the rainfall during the spring and early summer has a material effect on the local and annual abundance of the species.

The north-central part of the United States, including portions of the States of Minnesota, North and South Dakota, and Montana, seems to be freer from the pest than any other region. In fact, throughout considerable portions of this region ox warbles are entirely unknown. This is particularly true of those portions of North and South Dakota and western Minnesota included in the valley of the Red River of the North. An explanation for the absence of warbles from these areas is not apparent. It has been found that the species is absent from wooded regions as well as plains areas, and there is some difference in the rainfall within the non-infested region. In South Dakota it was observed that the warbles were to be found in the hilly region along the divides between rivers. Hence, it would appear that there is some relationship between the topography of the country and the occurrence of the species in that section. Prof. H. C. Severin states that he has observed this practical absence of warbles from eastern South Dakota,

and that a greater number occurs in the western part of the State. Dr. W. L. Boyd states that while warbles are rather common in southern Minnesota, he has never known an animal to become infested at the Experiment Station at St. Anthony Park. Dr. Boyd found 39% of two herds of dairy cattle, totaling 82 head, to be infested in the vicinity of Duluth. All of the specimens obtained from these herds proved to be *H. lineata*.

Although this species is present in a large percentage of the live stock in the central part of the Mississippi Valley, there is some indication that it is decreasing in numbers in this region, probably owing to the more extensive cultivation of the land and better care being given to the live stock. The heaviest infestation of this species which we have observed occurred in southwestern Texas, although it does not follow that this region is in general more heavily infested than others. Probably 75% of the cattle in the United States are more or less infested. The average number of warbles per animal ranges from one up to about one hundred. Many animals even in rather heavily infested herds, are entirely free.

The localities from which we have obtained specimens of this species are indicated on the accompanying map. Records made by other investigators are not included. These would add a large number of localities, including some of the States from which we have not obtained specimens.

DISTRIBUTION AND ABUNDANCE OF *Hypoderma bovis*.

As is shown on the accompanying map, this warble is rather widely distributed through the northern part of this country.¹ The north-eastern States have by far the greatest infestation, Vermont being the center of this heavily infested region. Although a considerable number of specimens of *H. lineata* were obtained from Vermont and New Hampshire, undoubtedly *H. bovis* occurs in greater numbers. This is also true of New York, and probably of Pennsylvania. St. Louis, Mo., was the

¹The counties from which we have obtained specimens of *H. bovis* are as follows: Alabama, Lee; Illinois, Cook; Iowa, Scott; Maine, Oxford; Maryland, Garrett; Michigan, Ingham; Montana, Fergus; Missouri, St. Louis; New Hampshire, Grafton, Merrimac, Rockingham; New York, Oneida, Onondaga, Ontario; Pennsylvania, Erie, Washington; Vermont, Bennington, Franklin, Orange, Orleans, Rutland, Washington, Windham, Windsor; Washington, Jan Juan.

southernmost point from which we obtained specimens of the so-called European ox warble. However, but a single grub was collected in this locality, and on account of the fact that this is a concentration center of considerable importance it may be that the infestation was recently introduced on cattle shipped from elsewhere and will not persist. The specimen taken was found on a dairy cow in a herd on the edge of the city. A well established center of infestation occurs almost as far south as

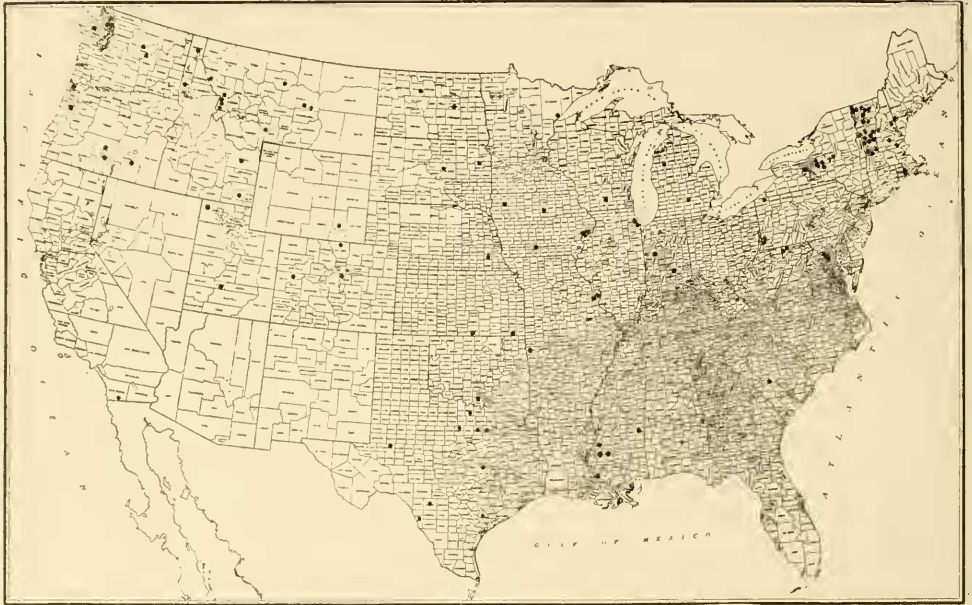


Fig. 1. Map showing the distribution of the ox warbles in the United States. The dots indicate where *Hypoderma lineata* has been collected in this investigation; the crosses indicate *Hypoderma bovis*.

St. Louis, at a point in western Maryland. This locality is in the Allegheny Mountains, and the infestation appears to extend continuously northward through Pennsylvania into New York. The correspondent who collected these specimens states that he does not know that any cattle have been brought into that locality from the north for a great many years. It was thought that possibly *H. bovis* might be best adapted to the conditions in the northern part of the country, especially along the mountain ranges. While this theory seemed to be fairly true for the eastern part of the country, it was not borne out by

findings in the West. As has been stated, Dr. Hadwen reported this species to occur commonly in eastern British Columbia, and one would expect this infestation to extend southward along the Rockies in the United States. However, only two lots of this species were obtained from the West. One of these from Waldron, Washington, consisted of one larva of *H. bovis* and five of *H. lineata*. This place is situated on an island in Puget Sound not far from the Canadian line. The other point of infestation was located at Garneil, Montana. Our correspondent there sent in two lots of warbles; the first contained one specimen of *H. bovis* and one of *H. lineata*; the second, three specimens of *H. bovis* and one of *H. lineata*. No information was secured regarding the possible mode of introduction of this species into Montana, although it is wellknown that pure blooded stock, particularly of the dairy types is brought in from the East. In the North Central States, three points of infestation were discovered. A well established infestation was found to occur at Davenport, Iowa. A correspondent at that point sent in three fourth-stage larvæ of *H. bovis* on April 26, 1915, and twenty larvæ in the same stage on May 6, 1915. No information was gained as to the possible origin of this infestation. On May 7, Mr. E. W. Laake and the writer obtained twelve fourth-stage larvæ in the back of a cow in the stock yards at Chicago, Ill. Four of these proved to be *H. bovis*. The origin of the infested animal could not be learned. The single occurrence of this species in Michigan was established through the collection of six larvæ by Dr. Shafer at East Lansing, on April 7, 1914. Two collections of larvæ from cattle at Cadillac, Michigan, by Mr. James F. Zimmer, prove to be composed entirely of *H. lineata*.

It would seem, therefore, that in the western two-thirds of the United States, *H. bovis* is to be found in rather restricted and well separated areas, although no doubt a thorough search would reveal a more general distribution than is now supposed to exist. In the Northeastern States this species predominates over *H. lineata*, both in distribution and abundance.

The writer is of the opinion that the European ox warble must have some well marked climatic barriers which have prevented its general dissemination throughout the country, as cattle, many of which are no doubt infested, are shipped annu-

ally to the Central and Southern States from New York and other States where this species commonly occurs. One explanation of this possible barrier will be found in the fact that *H. bovis* is generally later in emerging from the backs of cattle than *H. lineata*. The grubs emerging from the backs of cattle shipped to the Southern States would, on account of this later date of emergence, encounter excessively hot weather and this may account in part at least for the failure of the species to establish itself in the warmer portions of the country. It may be of interest to note that on April 23, 1914, Dr. W. E. Hinds sent in three specimens of this species from the experiment station at Auburn, Alabama. These were obtained from the back of a young bull which had recently been shipped from New York.